

Initial Startup of the DØ Silicon Detector Cooling System

Revision Log

Version Number	Date Approved	Pages Affected	Description of Revisions
1.0	1/15/01	All	Initial Issue

Approvals

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1 INTRODUCTION

1.1 Purpose

This procedure addresses the initial leak testing of the DØ SMT cooling system, followed by system flushing, instrument calibrations, and electrical isolation checks.

1.2 Scope and Applicability

The detector platform is assumed to be in the assembly hall. The leak testing includes three steps - (i) vacuum leak testing from the air separator tank to the bypass hoses on the CC faces for both the collision hall and assembly hall sides, (ii) pressure testing the system without the silicon, (iii) repeating the vacuum leak check with the system in its final operating state, including the silicon. Once leak-tight, the system is flushed. Flow, temperature, and pressure measuring devices are calibrated, and electrical isolation checks are performed.

2 PRECAUTIONS AND LIMITATIONS

- A. All instrumentation must be installed.
- B. All welds must be complete.
- C. All jumper hoses must be in place. Exact hose placements are itemized in the sub-procedures.

NOTE: *All tanks in the system are less than 120 gallons in size and will never be exposed to pressures greater than 300 psig, so they are not code-stamped vessels.*

3 PREREQUISITE ACTIONS

3.1 Documents

- [1] Obtain the operating manual for the flow meters to aid in their calibration.

3.2 Special equipment, tools, parts, and supplies

- [1] Obtain a helium leak detector and helium gas tank.
- [2] Obtain nitrogen gas source to use for pressurization.
- [3] Obtain bypass hoses and clamps.
- [4] Obtain bolt-on flange and bolts for expansion tank.
- [5] Obtain ohm-meter for electrical isolation checks
- [6] Obtain distilled water for system flushing.

4 PROCEDURE

4.1 Vacuum/Helium Leak Test – Assembly Hall

NOTE: *This leak test is performed from the air separator tank to the stainless steel hose barbs on the CC face. The platform piping up to the CC faces, the piping under the sidewalk on the assembly hall side, the instrumentation piping on the sidewalk, the #1 chiller, and the air separator tank are part of the system under test in this section. Bypass hoses are attached at the CC faces so that the silicon detector is not part of the system under test.*

- [1] Attach bypass hose from the supply side to the return side at the stainless hose barbs on the north CC face.
- [2] Attach bypass hose from the supply side to the return side at the stainless hose barbs on the south CC face.
- [3] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354 and #5343
 - [d] Chiller #2 isolation valves #5113 and #5111
- [4] Ensure that the expansion tank is flanged off.
- [5] Install the helium vacuum leak-testing equipment at the air separator tank on the sidewalk.
- [6] Vacuum leak test the system.

4.1 Vacuum/Helium Leak Test – Assembly Hall (continued)

- [7] Verify that no leak is detectable on the most sensitive scale of the helium leak detector with a minimum sensitivity of 10^{-9} atm/cc/sec.
- [8] IF a leak is detected, THEN perform and diagnostics and repairs as necessary to satisfy the leak rate requirement in step [7].

4.2 Vacuum/Helium Leak Test – Collision Hall

NOTE: *This leak test is performed from the air separator tank to the end of the collision hall piping. The piping under the sidewalk on the assembly and collision hall sides, the instrumentation piping on the sidewalk, the #1 chiller, and the air separator tank are part of the system under test in this section. A bypass hose is attached at the end of the collision hall piping so that the silicon detector and platform are not part of the system.*

- [1] Attach a manifold bypass hose from the two return lines to the supply line at the end of the collision hall piping under the sidewalk.
- [2] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354 and #5343
 - [d] Chiller #2 isolation valves #5113 and #5111
- [3] Install the helium vacuum leak testing equipment at the air separator tank on the sidewalk.
- [4] Vacuum leak test the system.
- [5] Verify that no leak is detectable on the most sensitive scale of the helium leak detector with a minimum sensitivity of 10^{-9} atm/cc/sec
- [6] IF a leak is detected, THEN perform and diagnostics and repairs as necessary to satisfy the leak rate requirement in step [5].

4.3 Pressure Test Supply Side – Assembly Hall

NOTE: *This pressure test is performed from the dry tank at the crane rail to the expansion tank. The supply piping under the sidewalk on the assembly hall side, the supply instrumentation piping on the sidewalk, the #1 chiller, the air separator tank, and the dry tank at the crane rail are part of the system under test in this section. The silicon detector is not part of the system under test.*

- [1] Attach a flange to the top of the expansion tank using bolts.
- [2] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354, #5343, and #5342
 - [d] Return isolation valves #5339, #5303, and #5313
 - [e] Chiller #2 isolation valves #5113 and #5111

CAUTION: *Failure to isolate the silicon detector in the following step could result in its overpressurization and damage.*

- [3] Disconnect the silicon detector from the stainless steel supply and return plumbing on the north and south CC faces.
- [4] Apply 15 psig to the system using nitrogen gas connected at the dry tank.

NOTE: *The estimated maximum system pressure on the tanks is 7 psig. The test pressure of 15 psig is ~200% of this maximum.*

- [5] Verify that there is no noticeable pressure drop after 16 hours.
- [6] Isolate the tanks by closing valves #5339, #5338, and #5204.
- [7] Repeat the pressure test on just the supply-side piping by applying the system pressure source at one of the sample port valves and re-verify that there is no noticeable pressure drop after 16 hours.
- [8] Pressurize the sidewalk piping, and the under-the-sidewalk piping to 37.5 psig.

NOTE: *The maximum operating pressure is 30 psig. The test pressure of 37.5 psig corresponds to 125% of this maximum.*

- [9] Verify that there is no noticeable pressure drop after 16 hours.

4.3 Pressure Test Supply Side – Assembly Hall (continued)

- [10] IF a leak is detected, THEN perform diagnostics and repairs as necessary to fix the leak.
- [11] Unbolt and remove the flange from the expansion tank

4.4 Pressure Test Return Side – Assembly Hall

NOTE: *The pressure test is performed from the dry tank at the crane rail to the piping on the return line on the CC face. The return piping under the sidewalk on the assembly hall side, the return instrumentation piping on the sidewalk, the #1 chiller, the air separator tank, and the dry tank at the crane rail are part of the system. The silicon detector is not part of the system.*

- [1] Attach a plug to each stainless steel return line hose barb on the CC faces.
- [2] Ensure that the expansion tank is open to atmosphere.
- [3] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122 and #5128
 - [c] Fill valves #5354 and #5343
 - [d] Supply isolation valves #5101, #5111, and #5121
 - [e] Chiller #2 isolation valves #5113 and #5111

CAUTION: *Failure to isolate the silicon detector in the following step could result in its overpressurization and damage.*

- [4] Disconnect the silicon detector from the stainless steel supply and return plumbing on the north and south CC faces.
- [5] Apply 15 psig to the system using nitrogen gas connected at the dry tank.

NOTE: *The maximum estimated system pressure is about 7 psi; applying 200% of this maximum is 15 psig.*

- [6] Verify that there is no noticeable pressure drop after 16 hours.
- [7] IF a leak is detected, THEN perform diagnostics and repairs as necessary to fix the leak.

4.5 Pressure Test Supply and Return Lines – Collision Hall

NOTE: *The pressure test is performed from the dry tank at the crane rail to the end of the collision hall piping on both the supply and return lines. Caps or a bypass hose are installed at the end of the collision hall piping. The piping under the sidewalk on the collision hall side, the instrumentation piping on the sidewalk, the #1 chiller, the air separator tank, and the dry tank at the crane rail are part of the system. The silicon detector and platform are not part of the system.*

- [1] Do one of the following:
 - [a] Attach caps to the ends of the supply and return lines at the end of the collision hall piping under the sidewalk, OR
 - [b] Attach a bypass hose to connect the three lines.
- [2] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354 and #5343
 - [d] Chiller #2 isolation valves #5113 and #5111

CAUTION: *Failure to isolate the silicon detector in the following step could result in its overpressurization and damage.*

- [3] Disconnect the silicon detector from the stainless steel supply and return plumbing on the north and south CC faces.
- [4] Apply 15 psig to the system using nitrogen gas connected at the dry tank.

NOTE: *The maximum estimated system pressure on the tanks is 7 psig; applying 200% of this maximum is 15 psig.*

- [5] Verify that there is no noticeable pressure drop after 16 hours.
- [6] IF a leak is detected, THEN perform diagnostics and repairs as necessary to fix the leak.

NOTE: *The following steps [7]-[10] repeat the test for the supply side only.*

- [7] Isolate the tanks by closing valves #5339, #5338, and #5204.
- [8] Pressurize the sidewalk piping, and under-the-sidewalk piping to 37.5 psig using nitrogen gas connected at the dry tank.

4.5 Pressure Test Supply and Return Lines – Collision Hall (continued)

NOTE: *The maximum operating pressure is 30 psig; applying 125% of this maximum is 37.5 psig.*

- [9] Verify that there is no noticeable pressure drop after 16 hours.
- [10] IF a leak is detected, THEN perform diagnostics and repairs as necessary to fix the leak.

4.6 Final Vacuum Leak Test, Including Silicon

NOTE: *This leak test is performed on all operational components from the dry tank on the crane rail through and including the silicon. The silicon detector, the platform piping, the piping under the sidewalk on the assembly hall side, the instrumentation piping on the sidewalk, the #1 chiller, the dry tank, and the air separator tank are all part of the system under test. This procedure should be repeated whenever the system is opened or modified.*

- [1] Connect the silicon to the rest of the system by reconnecting it to the stainless steel plumbing on the north and south faces of the CC.
- [2] IF the H-disks are not present, THEN cap off the H-disk ports on the H-disk manifolds.
- [3] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354, #5343 and #5342
 - [d] Chiller #2 isolation valves #5113 and #5111, if chiller #2 is not present.
- [4] Ensure that the expansion tank is sealed with a flange.
- [5] Ensure that the vacuum leak testing equipment is installed at the dryer tank on the crane rail or at the air separator tank on the sidewalk.
- [6] Vacuum leak test the system.
- [7] Verify that no leak is detectable on the most sensitive scale of the helium leak detector with a minimum sensitivity of 10^{-9} atm/cc/sec
- [8] IF a leak is detected, THEN perform diagnostics and repairs as necessary to fix the leak.

4.6 Final Vacuum Leak Test, Including Silicon (continued)

- [9] Remove the flange slowly from the expansion tank to vent it to atmosphere.
- [10] IF further testing is to be done, THEN disconnect the silicon detector from the plumbing on the north and south faces of the CC.

4.7 Flushing The System With Water – Under the Sidewalk

NOTE: *The plumbing is flushed with water to clean any debris from the piping. Filters should be in the system and replaced after the initial water flush has occurred. The flushing does not include any piping on the platform. The silicon manifolds are not part of the system being flushed.*

- [1] Connect the sidewalk jumper hose to the piping under the sidewalk.
- [2] Connect the collision hall and assembly hall pipes with jumpers by connecting the supply to the two returns.
- [3] Ensure that the following valves are closed:
 - [a] Drain valves #5343 and #5354
 - [b] Sample port valves #5122, and #5128
 - [c] Fill valves #5354, #5343 and #5342
 - [d] Bypass valves #5141, #5139, #5315, #5305, #5337, #5166
 - [e] Chiller #2 isolation valves #5113 and #5111
- [4] Fill the system with distilled, clean water using the supply port of chiller #2 or valve #5111 as the fill port.

NOTE: *The final fill level should be above the "Separator Tank Low" limit.*

- [5] Turn the vacuum pump on by following procedure DØ-OP-SMT-004 - "Operating the Silicon Detector Cooling System Vacuum Pumps".
- [6] Start the #1 chiller by following the chiller startup section of Procedure DØ-OP-SMT-008, "Normal Operation of the DØ Silicon Chiller System".
- [7] Run the system to clear air bubbles and to flush the system.

4.7 Flushing The System With Water – Under the Sidewalk (continued)

- [8] Open each of the following instrumentation bypass valves sequentially, allowing the bubbles to clear before proceeding to the next valve:
 - [a] Valve #5141
 - [b] Valve #5139
 - [c] Valve #5315
 - [d] Valve #5305
 - [e] Valve #5337
 - [f] Valve #5166
- [9] Shut the chiller off by following procedure DØ-OP-SMT-009, "Temporary Shutdown of Silicon Detector Chiller"
- [10] Replace the filters. Refer to the system flow diagram and the "Changing Filters" section of procedure DØ-MAINT-SMT-001.

4.8 Calibrating Instruments/Devices

NOTE: *Each instrument/device listed below should be calibrated before the silicon detector is part of the system.*

- [1] Ensure that the system is full of coolant liquid.
- [2] Calibrate the following flow measurement devices according to the manufacturer's instructions (see references):
 - [a] FT5130
 - [b] FT5350
 - [c] FT5349

4.9 Checking for Electrical Isolation

NOTE: *The piping system should be electrically isolated from building and other exterior grounds. All exposed metal pipe surfaces should be covered either with Kapton tape or foam insulation. The platform piping should be electrically isolated from the platform ground. Electrical isolation should be checked with an ohm-meter from each section of piping to ground. At least 3 M Ω should be measured between ground and any part of the silicon piping system.*

4.9 Checking for Electrical Isolation (continued)

- [1] Check for electrical isolation between the dry tank and building ground.
- [2] Check for electrical isolation between the air separator tank and building ground.
- [3] Check for electrical isolation between the chillers and building ground.
- [4] Check for electrical isolation between the sidewalk piping and building ground.
- [5] Check for electrical isolation between the under the sidewalk piping and building ground on both the collision hall and assembly hall sides.
- [6] Check for electrical isolation between the platform piping and platform ground.
- [7] Isolate any sections of piping that do not meet the 3 M Ω requirement.

5 REFERENCES

- A. FESHM #5031, Pressure Vessels
- B. Flow diagram, DWG #900790, sheets 1 and 2
- C. Mechanical layout drawings, DWGs #386983 and #900629
- D. Flow meter operating manuals
- E. Procedure DØ-MAINT-SMT-001, "SMT Coolant System Maintenance".